

e/γ Calibration and Performance with DC1



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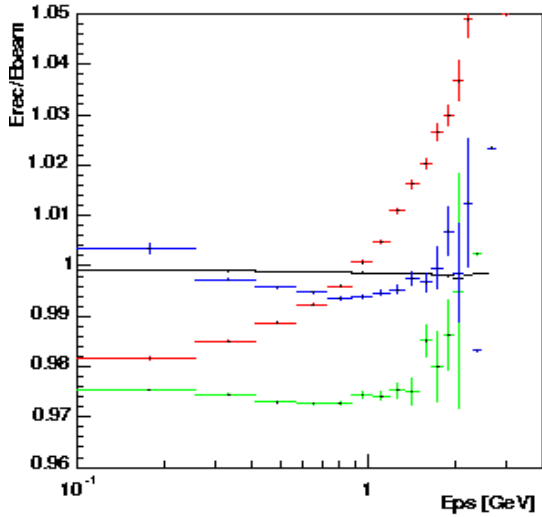
Introduction

- ◆ A big part of our group is involved in Higgs analyses
- ◆ Thus we have large DC1 samples with W,Z e/g jets etc (all available in castor)
- ◆ When attempting physics analyses with full sim, one has to deal with calibration issues which is obvious for e/ γ p_{T} Miss etc.
- ◆ So, typically one stops and starts studying calibration issues, looking at TBeam results.
- ◆ This may be a “top- \rightarrow bottom” approach but several people in ATLAS are trying to do physics analyses with full-sim: we decided to check ideas obtained by EMBarred TBeam studies and work closer with some LAr experts.

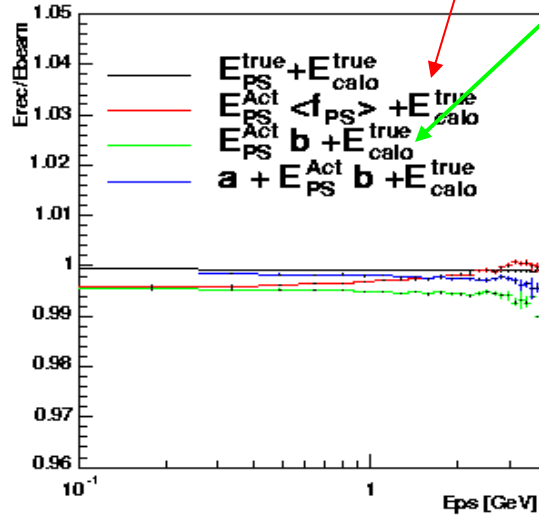
ATLAS TB-MC: T.Carli offset makes possible simultaneous optimization of linearity and resolution

Set: $E_{\text{calo}} = E_{\text{calo}}^{\text{true}}$

E = 10.00 GeV

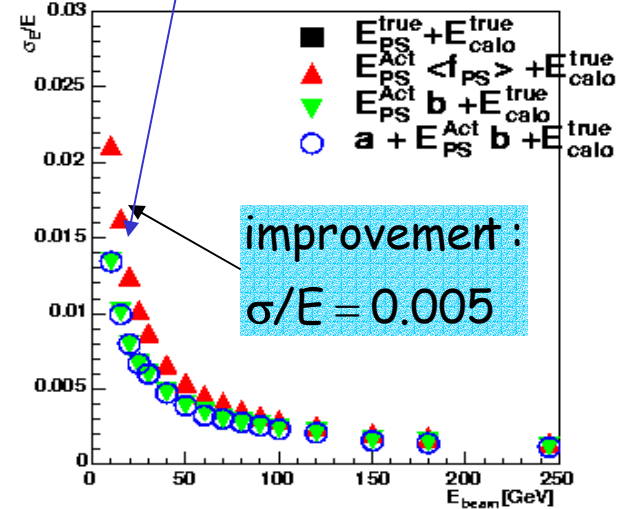
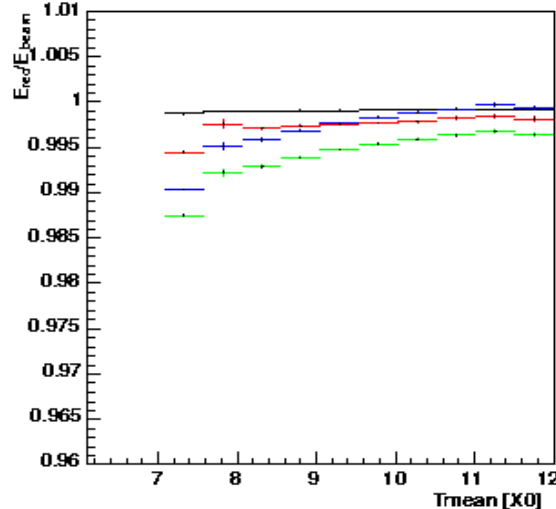
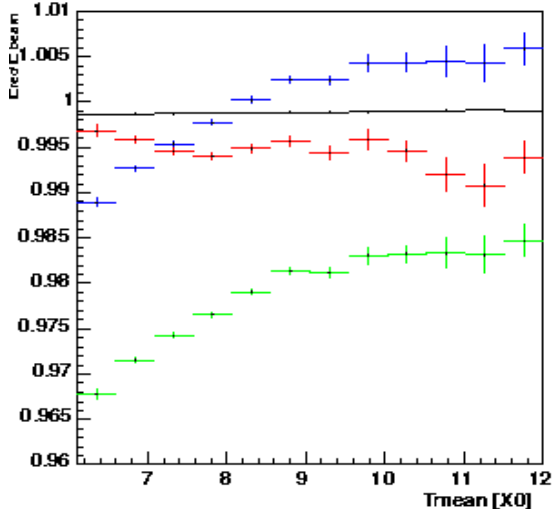
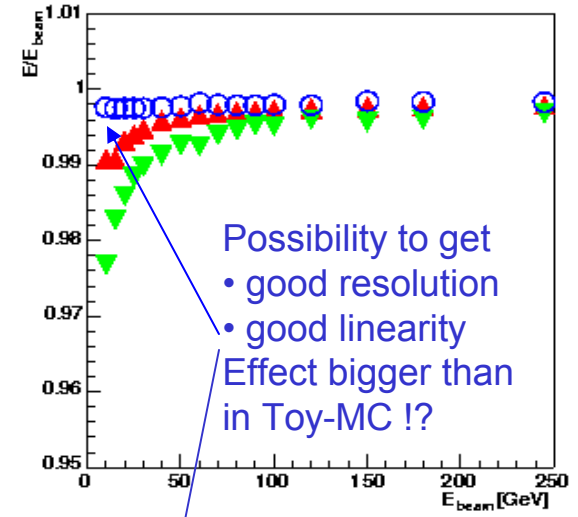


E = 100.00 GeV



resolution optimised

All E



Electrons (DC1)

$$E_{rec} = \lambda \left(b + W_0 E_{pres} + E_1 + E_2 + W_3 E_3 \right)$$

- ◆ Extract λ, b, W_0 and W_3 in 55 η bins $\eta < 0.025$
- ◆ Apply them at the CBNT sampling energies
- ◆ Make sure everything done in ATHENA is corrected

For DC1 we obtained new sets of electron-based EM weights

ATLAS Electromagnetic Calorimeter calibration and shower isolation studies with an application to the $H \rightarrow ZZ^{(*)} \rightarrow 4e$ analysis

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Abstract

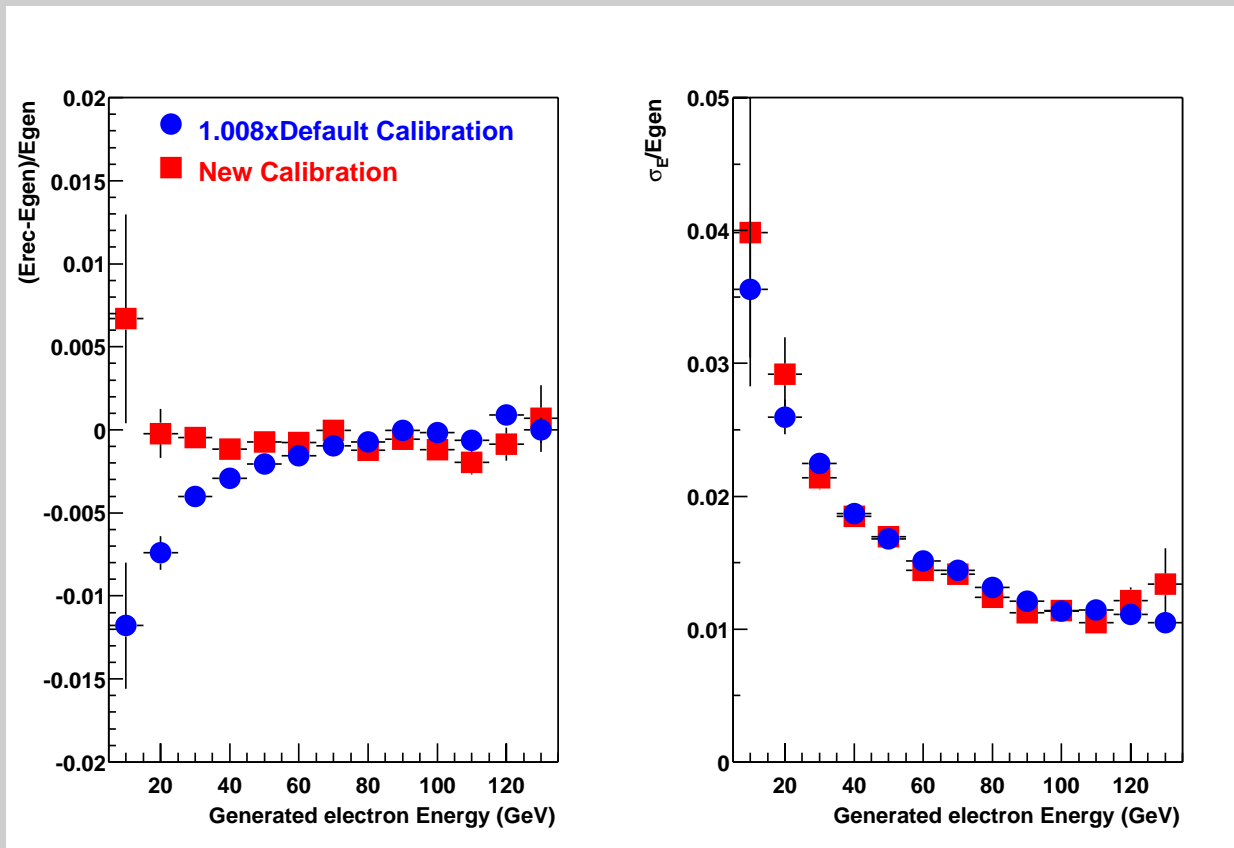
In this note a full electron-based calibration of the Electromagnetic Barrel Calorimeter is performed. The improvement in resolution and linearity for electrons of energies ranging from 10 GeV up to the TeV scale is demonstrated. A new general method is proposed which can be applied to multi-lepton final states where detector level information is exploited to discriminate between signal and background. The method is applied to the $H \rightarrow ZZ^{(*)} \rightarrow 4e$ channel.

- ◆ What was done and how including the extracted weights is described in

ATL-COM-GEN-2004-003

- ◆ There were requests by people who do analysis for methods doing these corrections at CBNT level.
- ◆ SP provided the code and he can help anybody who wants to try this out in his analysis
- ◆ **DC2: NO PROBLEM** cluster level corrections can be trivially applied (they are not hardcoded)

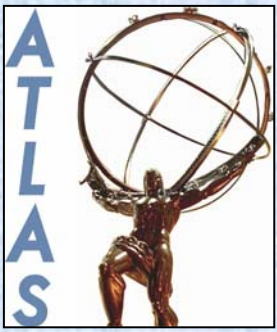
Lower energy electrons



- ◆ Linearity is improved without deterioration of the resolution

High and very high energy electrons

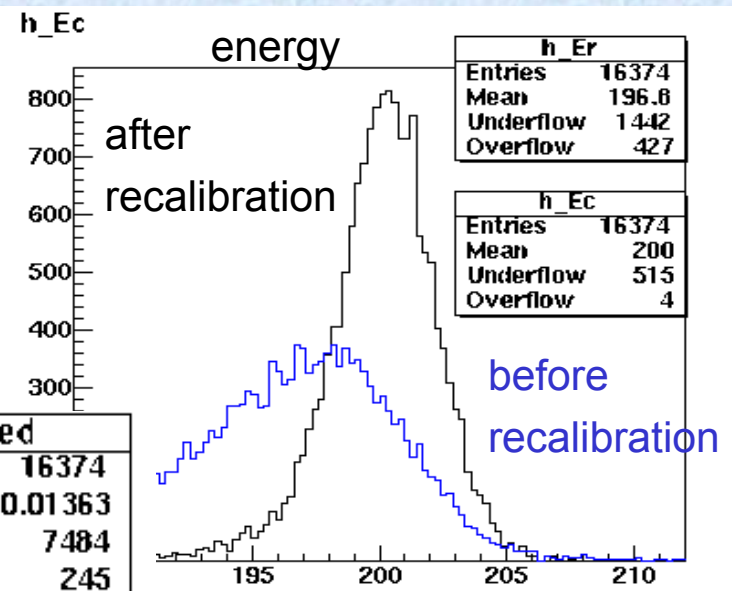
- Thanks to Martina Schaefer (Grenoble) who applied the weights to an analysis which uses high energy electrons (here the offset plays no role)
- Application to $Z' \rightarrow e^+e^-$ (exotics group analysis)
- Good resolution and linearity is crucial for fitting the mass and discriminating between different models



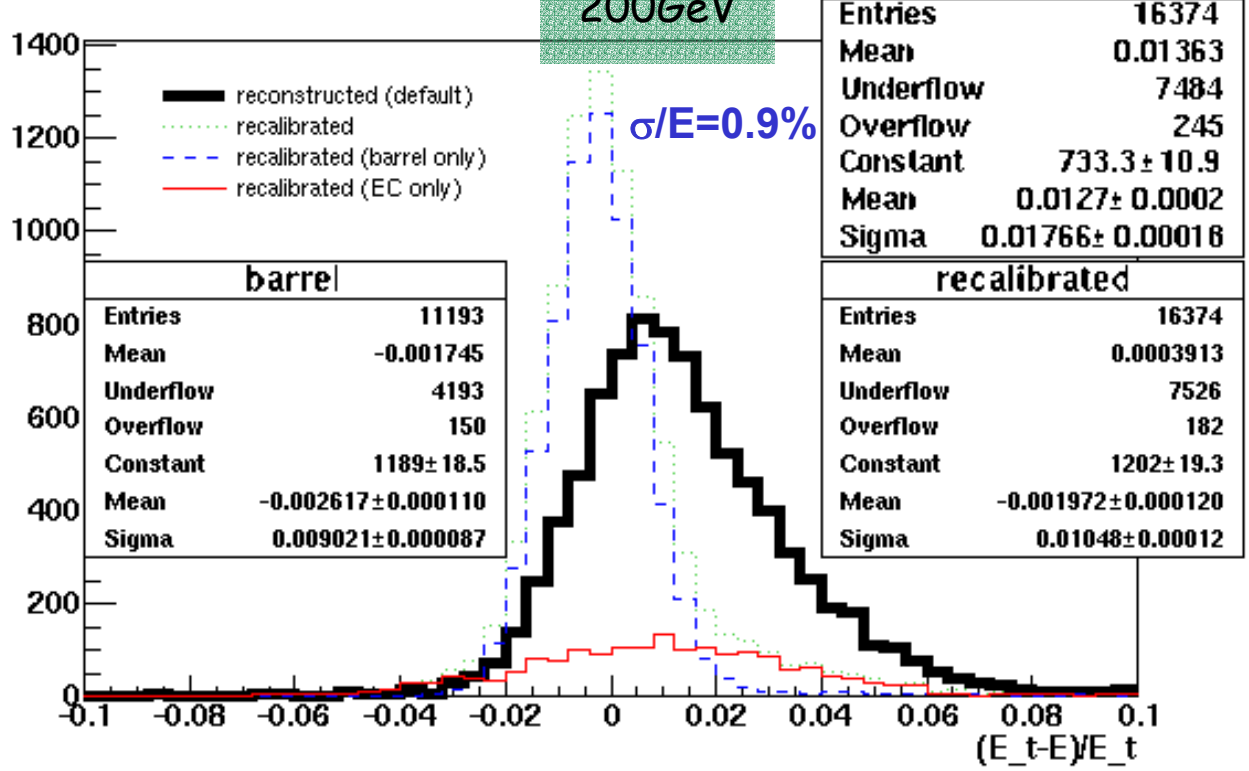
Calibration (1)



- x "standard" calibration : photons
 - x de-calibration
 - x re-calibration
 - x only barrel
- } Stathes Paganis



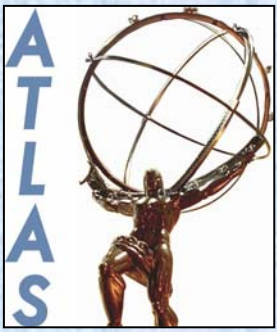
resolution electrons 200GeV



$$\sigma(E)/E \text{ (E=200GeV)}$$

$$= 9.5\% \sqrt{E}^{-1} + 0.45\%$$

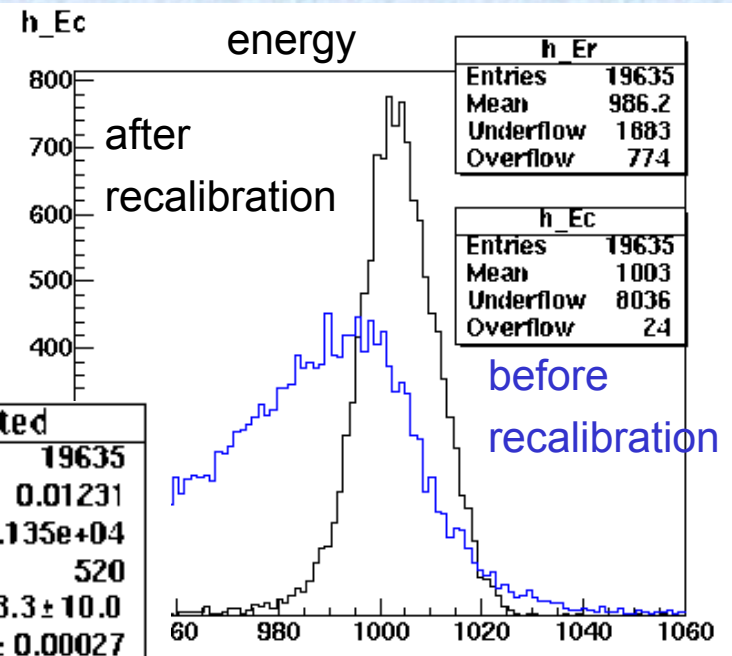
$$\approx 0.8\% \text{ ok}$$



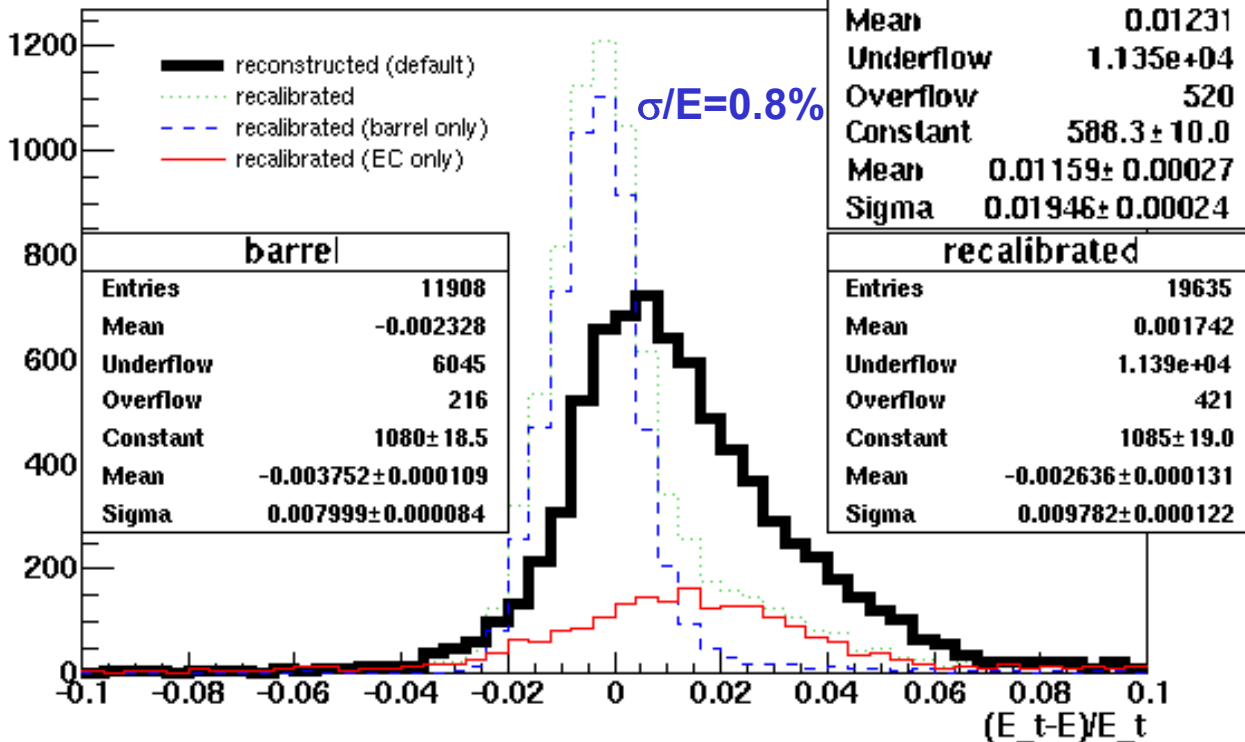
Calibration (2)



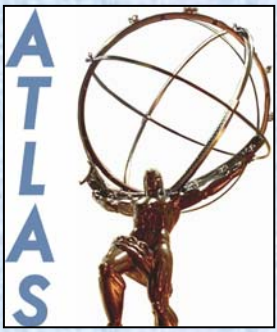
1TeV



resolution electrons 1000GeV



$$\sigma(E)/E \text{ (E=1000GeV)} = 9.5\% \sqrt{E}^{-1} + 0.45\% \approx 0.5\%$$



Calibration (3)



Results on the Z' (SSM 1.5TeV), electrons at about 750GeV

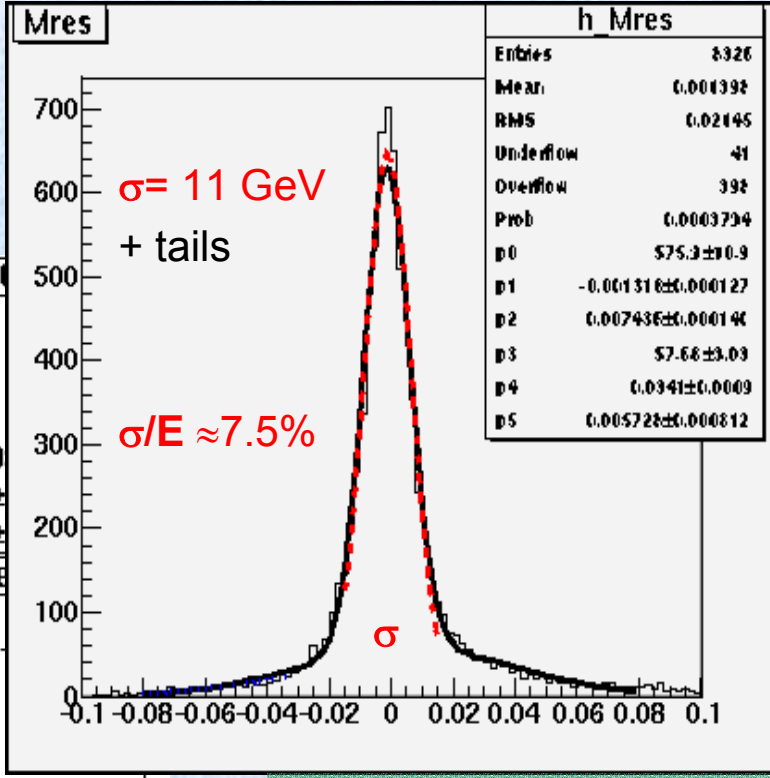
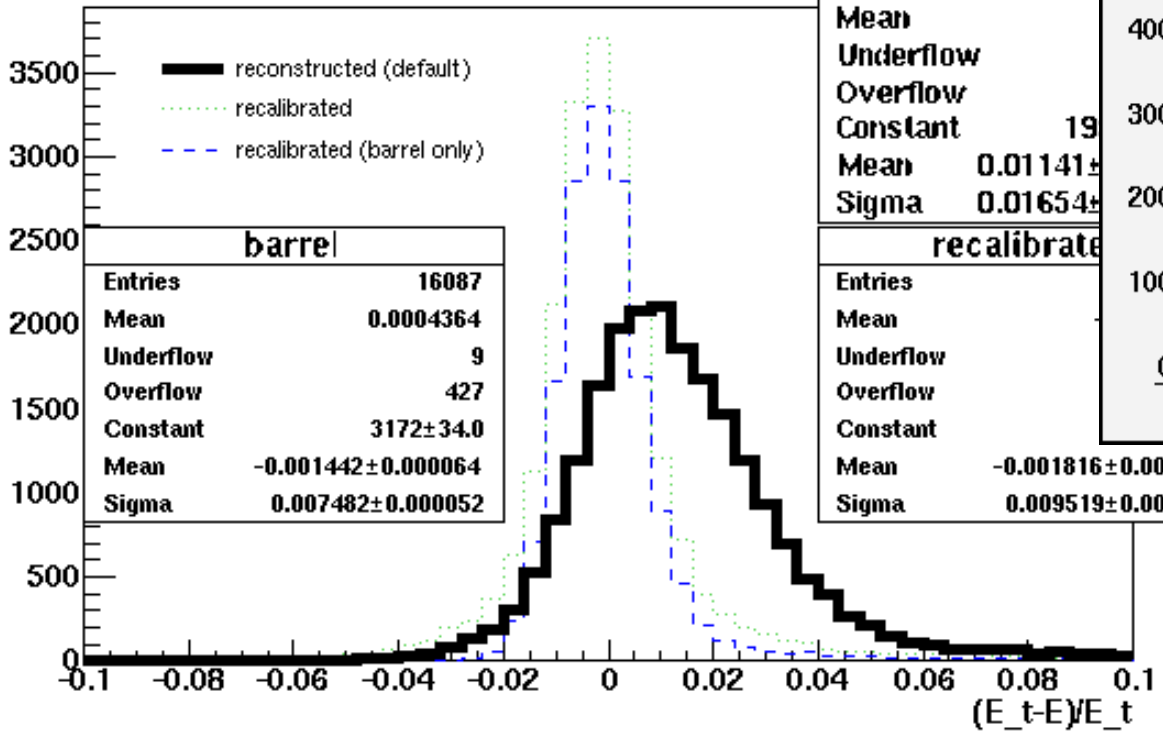
$$\sigma(E)/E \text{ (E=750GeV)} = 9.5\% \sqrt{E}^{-1} + 0.45\% \approx 0.6\% \text{ ok}$$

$$\sigma(M)/M \text{ (M=1.5TeV)} = \sqrt{2} \sigma(E)/E \approx 0.8\% \text{ ok}$$

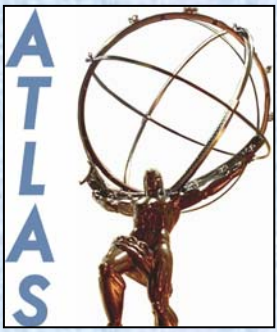
resolution of electrons (Z' at 1.5TeV)

resolution SSM 1.5TeV

$$\sigma/E \approx 0.7\%$$



resolution on the mass (for 1.5TeV)

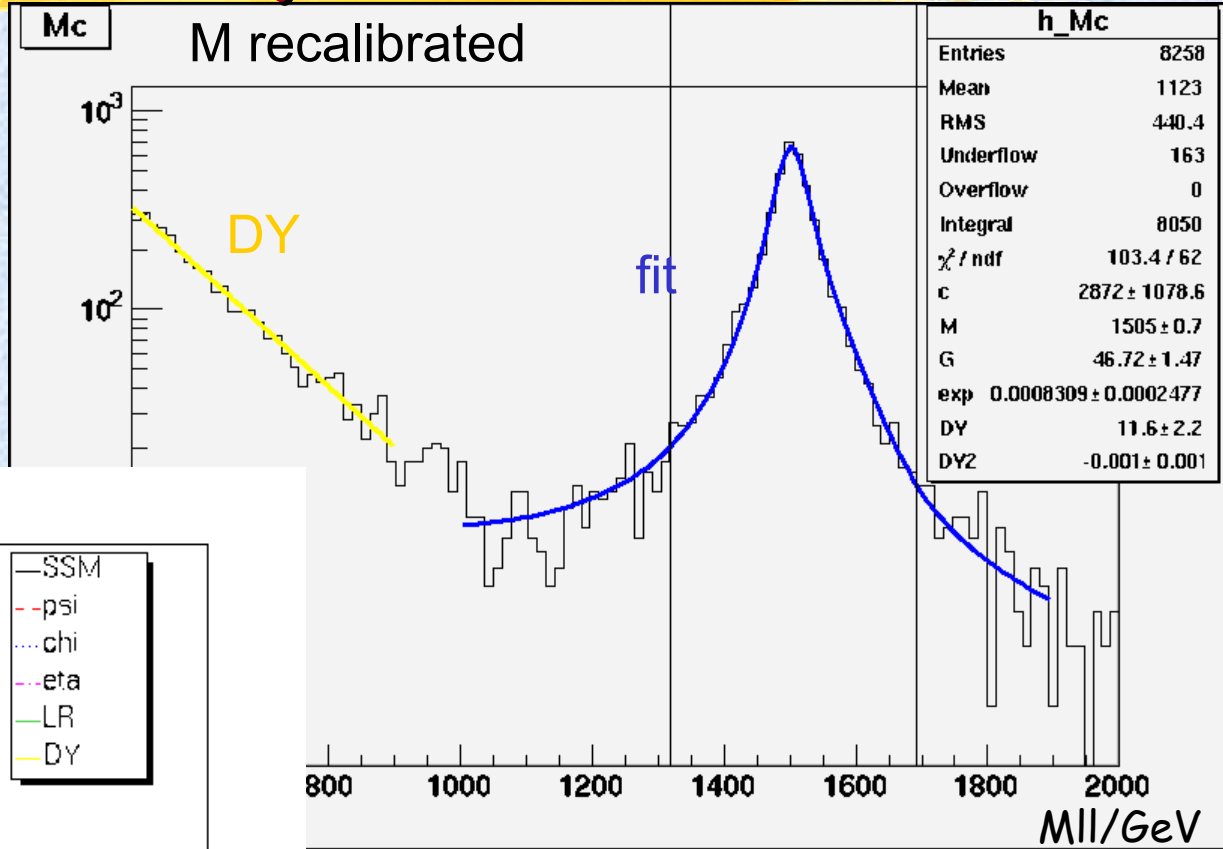


Total decay width (3)

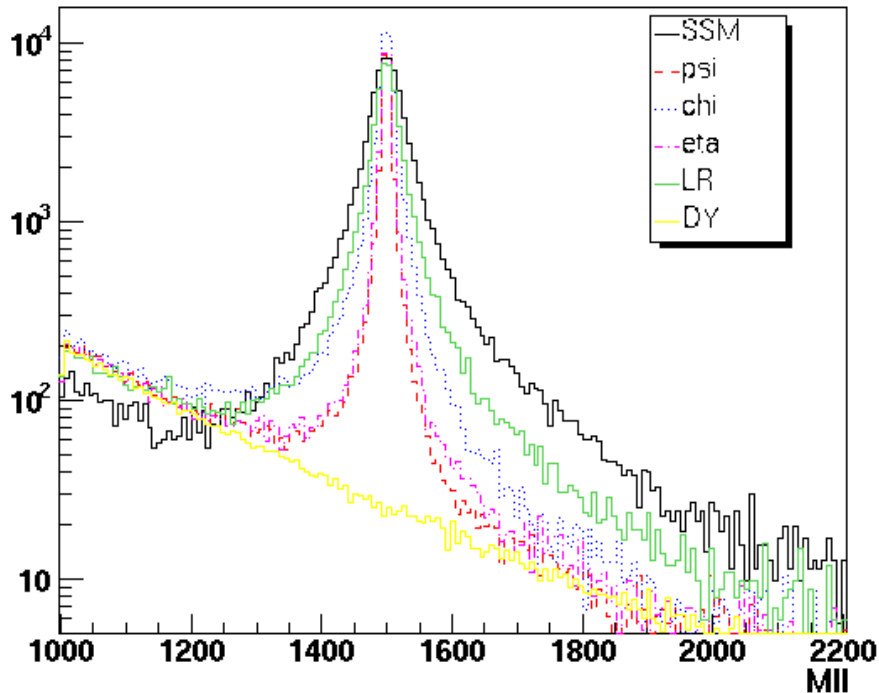


1.5TeV

all models (generation)



Z' 1.5TeV



full sim, SSM 1.5TeV

Conclusion on electrons:

- ◆ (Obvious): calibration has to be e-based
- ◆ At low energies the “offset” parameter improves the linearity
- ◆ The extracted weights with lower energy electrons seem well behaved at high and very high energies
- ◆ Impact on Physics: certain analyses (like the Z' (TeV)) cannot be done with full-sim without proper calibration

**Photons: can anything be done?
(DC1)**

e/γ dependent Calibration Algorithm (a first simple criterion)

For track-matched clusters we apply electron based calibration:

$$E_{rec} = \lambda \left(b + W_0 E_{pres} + E_1 + E_2 + W_3 E_3 \right)$$

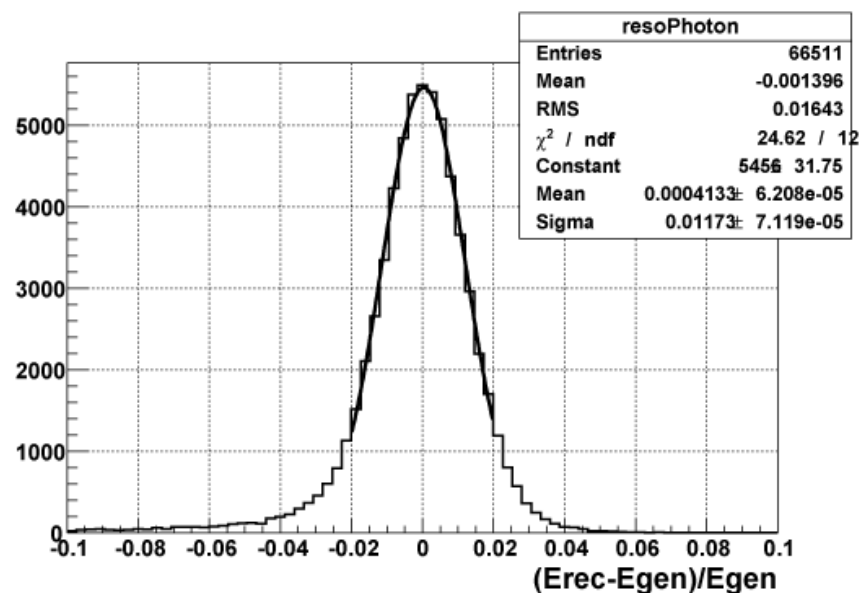
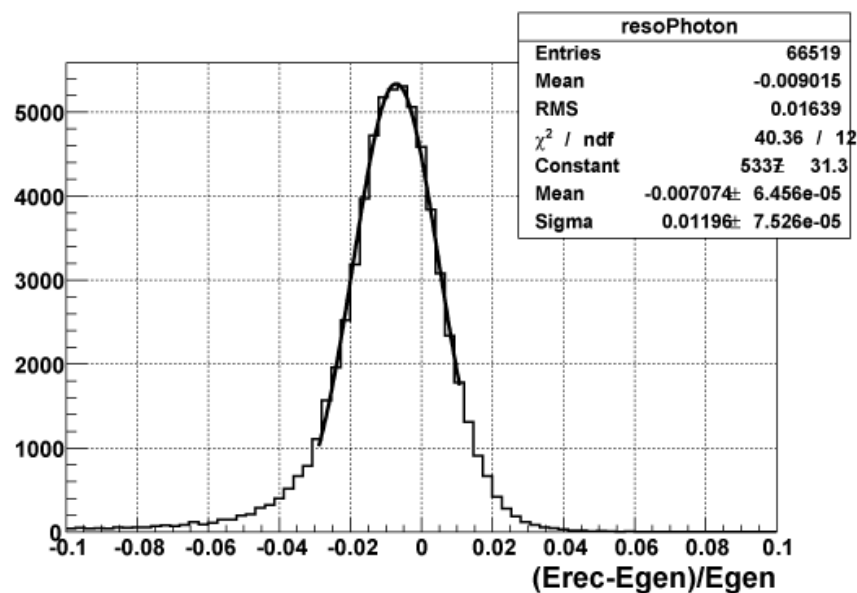
For un-matched clusters we apply photon based calibration:

$$E_{rec} = \lambda_{\gamma} \left(W_{\gamma 0} E_{pres} + E_1 + E_2 + W_{\gamma 3} E_3 \right)$$

Correction un-matched EM clusters (XKalman tracks)

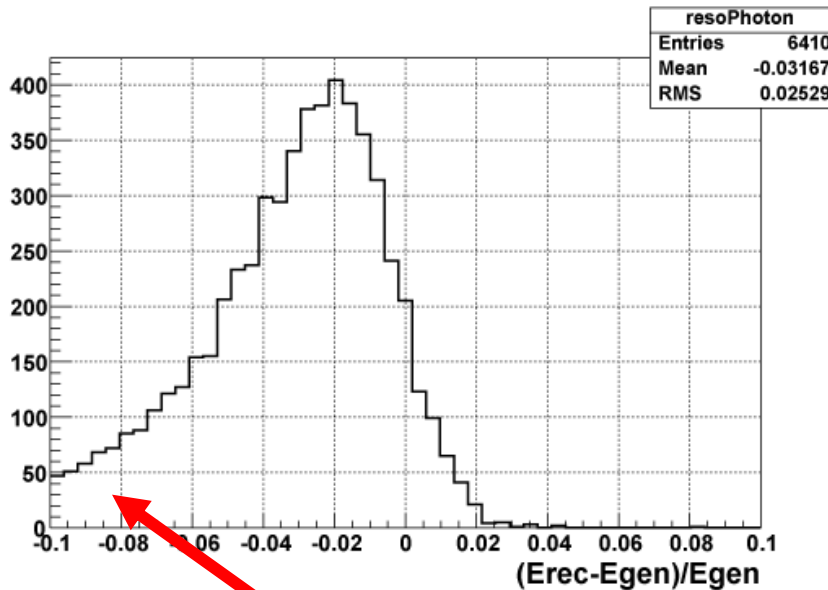
DC1 Calibration

After Correction
(Photon specific)

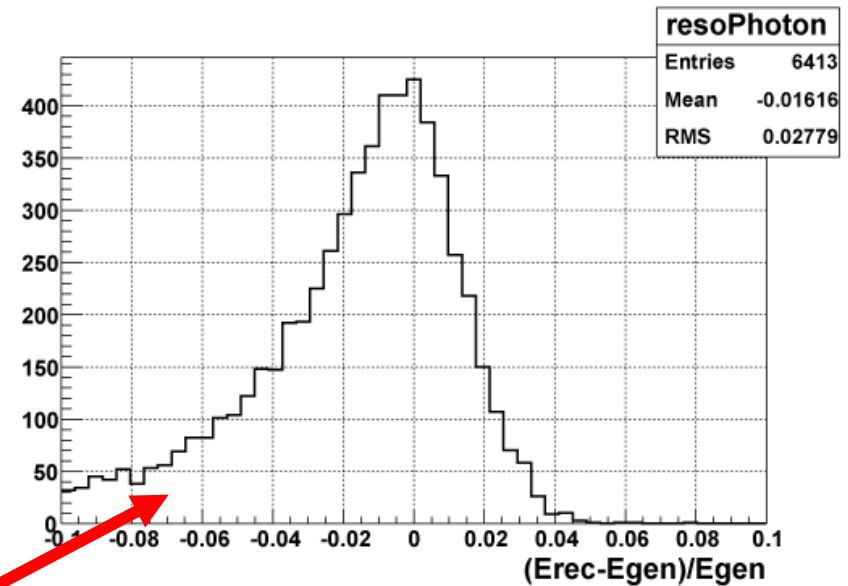


Calibration for converted Photons using track-match tag

Before Calibration

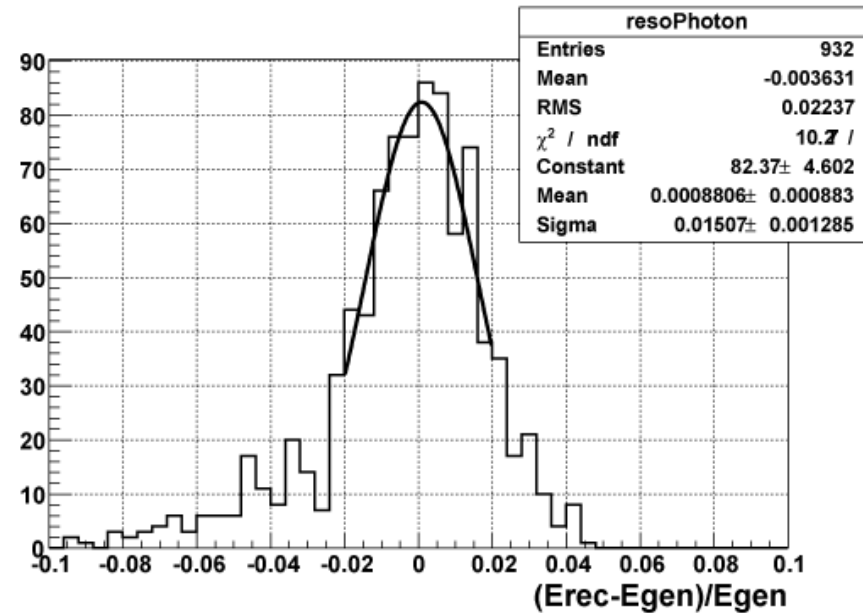
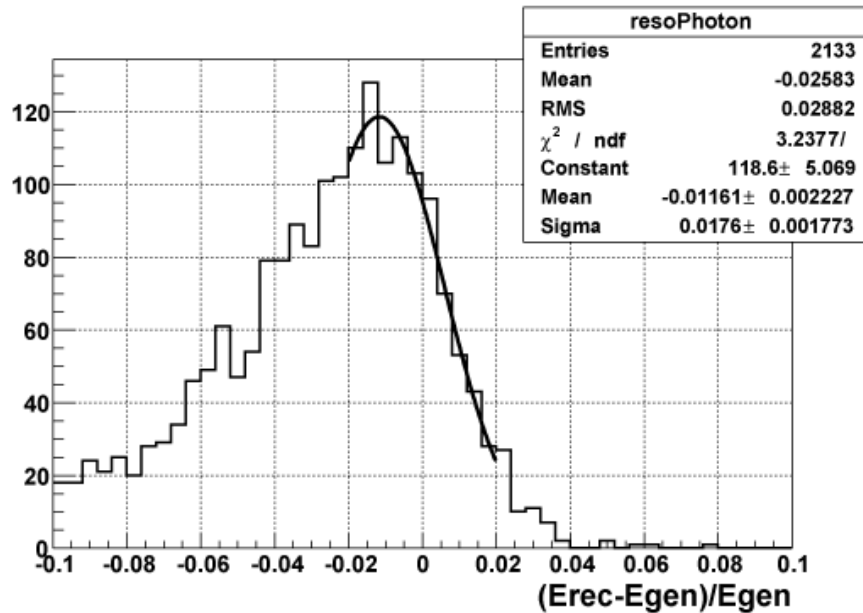


After Calibration
(electron calibration)



Tail? dominated by early asymmetric conversions?

Early asymmetric Vs relatively late symmetric conversions



Very Early: $R_v < 150\text{mm}$

Asymmetric: $E_{e^+} / (E_{e^+} + E_{e^-}) > 0.8$

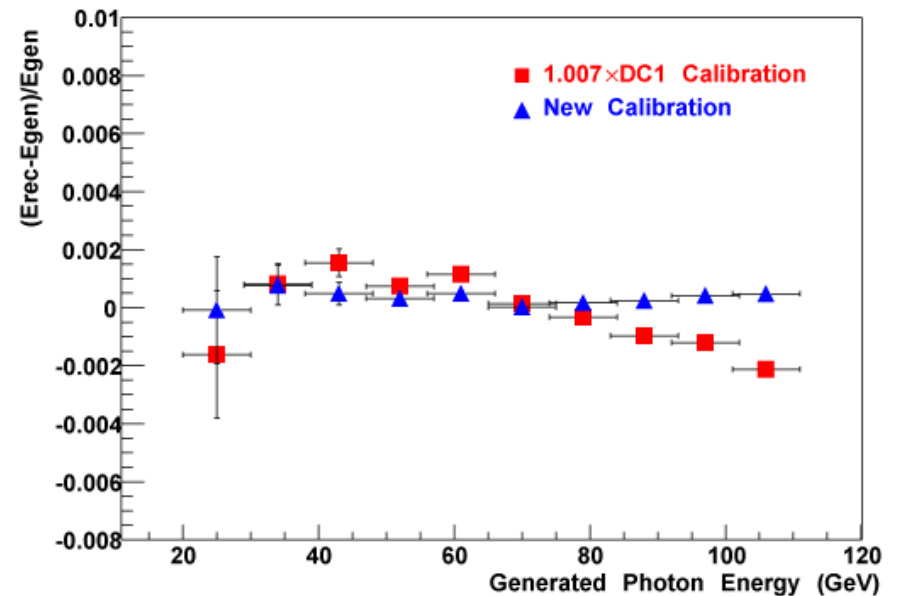
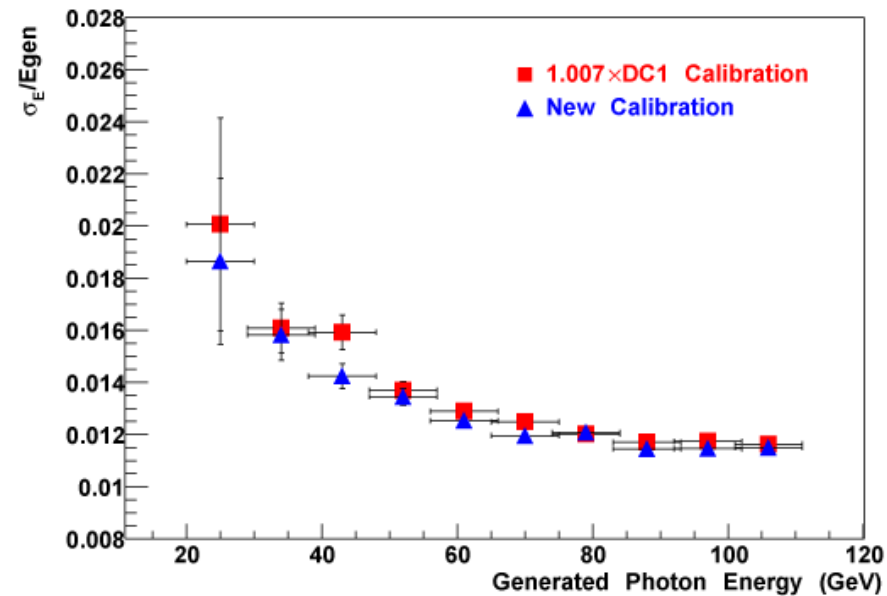
or $E_{e^+} / (E_{e^+} + E_{e^-}) < 0.2$

Relatively Late: $R_v > 150\text{mm}$

Symmetric: $E_{e^+} / (E_{e^+} + E_{e^-}) < 0.7$

and $E_{e^+} / (E_{e^+} + E_{e^-}) > 0.3$

Calibration Performance: photon linearity



Clear improvement in Linearity is seen

Conclusion on photons:

- ◆ It is encouraging that a pid specific algorithm may improve linearity/resolution
- ◆ But, we don't really understand what are the underlying effects:
 - Most (80%) of the photons convert, mostly asymmetrically
 - But only a small fraction of them (10%?) decay early enough to be identified by the ID.
 - So in ATLAS the photon is really ~2 electrons!
 - We also have ~5% non-interacting photons (no PS signal)
- ◆ Topological clustering should provide more info (Boonekamp et al)
- ◆ TBeam data important (but systematic errors may be large)

DC2: what's next + work-plan

- ◆ Need electron Samples out to $|\eta|=2.5$
 - We produced 20,50,100 GeV for $|\eta|<1.37$ (in Castor)
 - There will be some official major production soon
- ◆ We need a ClusterCorrectionTool
 - This should read from a file or dBase and apply corrections at the cluster level (Karina Loureiro+...)
- ◆ Look more carefully at photons and conversions (using e/ γ samples)
- ◆ TestBeam04 cross-checks (KL+SP)
- ◆ Impact on Physics (difficult without full validated samples)